CLAIMS

I CLAIM:

1. A soft-reference magnetic memory digitizing device comprising:

an array of soft-reference magnetic memory cells, each characterized by an alterable orientation of magnetization, the orientation changing upon the substantially proximate application of at least one externally-applied magnetic field as applied by a magnetically tipped stylus.

2. A soft-reference magnetic memory digitizing device comprising:

an array of soft-reference magnetic memory cells, each characterized by an alterable orientation of magnetization, the orientation changing upon the substantially proximate application of at least one externally-applied magnetic field; and

at least one magnetically tipped stylus for applying at least one external magnetic field to at least one magnetic memory cell of the array.

3. The soft-reference digitizer of claim 2, further comprising a display coupled to the array of magnetic memory cells such that the orientation of a given memory cell is used locally within the display to determine the information displayed upon the display proximate to the given memory cell.

4. A soft-reference magnetic memory digitizing device comprising:

an array of soft-reference magnetic memory cells, each memory cell including:

at least one ferromagnetic sense layer characterized by an alterable orientation of magnetization, the orientation changing upon the substantially proximate application of at least one externally-applied magnetic field;

at least one ferromagnetic soft-reference layer having a non-pinned orientation of magnetization; and

at least one intermediate layer forming a magnetic tunnel junction between the sense layer and the soft-reference layer,

wherein the alterable orientation of the sense layer is not substantially affected by the soft-reference layer; and

at least one magnetically tipped stylus for applying at least one external magnetic field to at least one magnetic memory cell of the array.

5. The soft-reference digitizer of claim 4, wherein the sense layer has a higher coercivity than the soft-reference layer.

6. The soft-reference digitizer of claim 4, wherein the magnetic tip of the stylus is a permanent magnet.

7. The soft-reference digitizer of claim 4, wherein the magnetic tip of the stylus is a current-carrying coil.

8. The soft-reference digitizer of claim 4, further comprising a display coupled to the array of magnetic memory cells such that the orientation of a given sense layer is used locally within the display to determine the information displayed upon the display proximate to the given sense layer.

9. The soft-reference digitizer of claim 4, further comprising a display characterized by an array of pixels, the display at least partially integrated with the array of magnetic memory cells, each memory cell further being coupled to at least one pixel.

10. A soft-reference magnetic memory digitizing device comprising:

a plurality of magnetic memory cells, each memory cell including:

at least one ferromagnetic sense layer characterized by an alterable orientation of magnetization, the orientation changing upon the substantially proximate application of at least one externally-applied magnetic field;

an intermediate layer in contact with the sense layer; and

at least one ferromagnetic soft-reference layer having a non-pinned orientation of magnetization; the reference layer in contact with the intermediate layer, opposite from the sense layer,

wherein the alterable orientation of the sense layer is not substantially affected by the soft-reference layer; and

at least one magnetically tipped stylus for applying at least one external magnetic field to at least one magnetic memory cell of the array.

11. The soft-reference digitizer of claim 10, wherein the sense layer has a higher coercivity than the soft-reference layer.

12. The soft-reference digitizer of claim 10, wherein the magnetic tip of the stylus is a permanent magnet.

13. The soft-reference digitizer of claim 10, wherein the magnetic tip of the stylus is a current-carrying coil.

14. The soft-reference digitizer of claim 10, further comprising a display coupled to the array of magnetic memory cells such that the orientation of a given sense layer is used locally within the display to determine the information displayed upon the display proximate to the given sense layer.

15. The soft-reference digitizer of claim 10, further comprising a display characterized by an array of pixels, the display at least partially integrated with the array of magnetic memory cells, each memory cell further being coupled to at least one pixel.

16. A method of using a soft-reference magnetic memory digitizing device comprising:

providing an array of soft-reference magnetic memory cells, each characterized by a sense layer having an alterable orientation of magnetization and a soft-reference layer, the orientation of the sense layer changing upon the substantially proximate application of at least one externally-applied magnetic field; and

applying an external magnetic field to at least a portion of the array to change the magnetic orientation of at least one memory cell;

reading the array by applying a sense current to the magnetic memory cells and reading the resistance of each cell, the sense current also sufficient to establish a magnetic field to orient the soft-reference layer during the read operation; and

refreshing the array by applying a refresh current sufficient to align substantially all the memory cells to a predetermined orientation.

17. The method of claim 16, further including initializing the array by applying an initialize current sufficient to align substantially all the sense layers to a predetermined orientation.

18. The method of claim 16, further comprising displaying an image upon a display, the image corresponding to the applied external magnetic field as determined by the resistance of each cell within the array.

19. The method of claim 18, wherein the display is comprised of an array of pixels, the display at least partially integrated with the array of magnetic memory cells, each memory cell further being coupled to at least one pixel.

20. The method of claim 16, wherein the condition of the digitizing device continuously cycles between reading and refreshing.

21. A method of using a soft-reference magnetic memory digitizing device having an array of magnetic memory cells, each memory cell characterized by at least one ferromagnetic sense layer characterized by an alterable orientation of magnetization, the orientation changing upon the substantially proximate application of at least one externally-applied magnetic field; and at least one ferromagnetic soft-reference layer having a non-pinned orientation of magnetization; wherein the alterable orientation of the sense layer is not substantially affected by the soft-reference layer, the method comprising:

applying an external magnetic field to at least a portion of the array to change the magnetic orientation of at least one sense layer;

reading the array by applying a sense current to the magnetic memory cells and reading the resistance of each cell, the sense current also sufficient to establish a magnetic field to orient the soft-reference layer during the read operation; and

refreshing the array by applying a refresh current sufficient to align substantially all the sense layers to a predetermined orientation.

22. The method of claim 21, further including initializing the array by applying an initialize current sufficient to align substantially all the sense layers to a predetermined orientation.

23. The method of claim 21, further comprising displaying an image upon a display, the image corresponding to the applied external magnetic field as determined by the resistance of each cell within the array.

24. The method of claim 23, wherein the display is comprised of an array of pixels, the display at least partially integrated with the array of magnetic memory cells, each memory cell further being coupled to at least one pixel.

25. The method of claim 21, wherein the condition of the digitizing device continuously cycles between reading and refreshing.

26. A method of using a soft-reference magnetic memory digitizing device comprising:

providing an array of magnetic memory cells, each memory cell including:

at least one ferromagnetic sense layer characterized by an alterable orientation of magnetization, the orientation changing upon the substantially proximate application of at least one externally-applied magnetic field;

an intermediate layer in contact with the sense layer; and

at least one ferromagnetic soft-reference layer having a non-pinned orientation of magnetization; the reference layer in contact with the intermediate layer, opposite from the sense layer;

wherein the alterable orientation of the sense layer is not substantially affected by the soft-reference layer;

applying an external magnetic field to at least a portion of the array to change the magnetic orientation of at least one sense layer;

reading the array by applying a sense current to the magnetic memory cells and reading the resistance of each cell, the sense current also sufficient to establish a magnetic field to orient the soft-reference layer during the read operation; and

refreshing the array by applying a refresh current sufficient to align substantially all the sense layers to a predetermined orientation.

27. The method of claim 26, further including initializing the array by applying an initialize current sufficient to align substantially all the sense layers to a predetermined orientation.

28. The method of claim 26, further comprising displaying an image upon a display, the image corresponding to the applied external magnetic field as determined by the resistance of each cell within the array.

29. The method of claim 28, wherein the display is comprised of an array of pixels, the display at least partially integrated with the array of magnetic memory cells, each memory cell further being coupled to at least one pixel.

30. The method of claim 26, wherein the condition of the digitizing device continuously cycles between reading and refreshing.